KSB RPH-V

Vertical Process Pump
according to API 610
as per Directive 94/9/EC

Works Nº: _____

Type series: _____

These operating instructions contain fundamental information and precautionary notes. Please read the manual thoroughly prior to installation of unit, connection to the power supply and commissioning. It is imperative to comply with all other operating instructions referring to components of this unit.

This manual shall always be kept close to the unit´s location of operation or directly on the pump set.

KSB Bombas Hidráulicas SA
Rua José Rabello Portella, 400
Várzea Paulista SP 13220-540
Brazil http://www.ksb.com
phone.: 55 11 4596 8500 Fax: 55 11 4596 8580
SAK – KSB Customer Service
e-mail: gqualidade@ksb.com.br
Fax: 55 11 4596 8656

Contents

		Page
1	**General**	**4**
2	**Safety**	**4**
2.1	Marking of Instructions in the manual	4
2.2	Personnel qualification and training	4
2.3	Non-compliance with safety instructions	4
2.4	Safety awareness	4
2.5	Safety instructions for the operator / user	4
2.6	Safety instructions for maintenance, inspection and installation work	5
2.7	Unauthorized modification and manufacture of spare parts	5
2.8	Unauthorized modes of operation	5
2.9	Explosion protection	5
2.9.1	Unit fill	5
2.9.2	Marking	5
2.9.3	Checking the direction of rotation	5
2.9.4	Pump operating mode	5
2.9.5	Temperature limits	6
2.9.6	Maintenance	6
3	**Transport and interim storage**	**6**
3.1	Transport	6
3.2	Interim storage (indoors) / preservation	7
4	**Description of the product an accessories**	**7**
4.1	Technical specification	7
4.2	Designation	7
4.3	Design details	7
4.3.1	Pump casing	7
4.3.2	Impeller form	7
4.3.3	Shaft seal	7
4.3.4	Bearings	8
4.3.5	Permissible forces and moments at the discharge nozzle	8
4.3.6	Noise characteristics	8
4.3.7	Technical data table	9
4.4	Accessories	9
4.5	Dimensions and Weights	9
5	**Installation at site**	**9**
5.1	Safety regulations	9
5.2	Checks to be carried out prior to installation	9
5.2.1	Place of installation	9
5.3	Soleplate foundation, settle and leveling	9
5.4	On a nozzle of a pressure vessel	10
5.5	Aligning the pump / drive	10
5.5.1	Aligning the complete unit	10
5.6	Connecting the piping	10
5.6.1	Auxiliary connections	11
5.6.2	Contact guard	11
5.7	Final check	11
5.8	Connection to power supply	11
6	**Commissioning, start-up / shutdown**	11
6.1	Commissioning	11
6.1.1	Lubricants	11
6.1.2	Shaft seal	12
6.1.3	Priming the pump and checks to be carried out	12
6.1.4	Checking the direction of rotation	12
6.1.5	Cleaning the sump or pressure vessel	13
6.1.6	Start-up	13
6.1.7	Shutdown	13
6.2	Operating limits	13
6.2.1	Temperature of the fluid handled, ambient temperature, bearing temperature	13
6.2.2	Switching frequency	13
6.2.3	Density of fluid pumped	13
6.2.4	Abrasive fluids	13
6.2.5	Minimum / maximum flow	14
6.3	Shutdown / storage / preservation	14
6.3.1	Storage of new pumps	14
6.3.2	Measures to be taken for prolonged shutdown	14
6.4	Returning to service after storage	14
7	**Servicing / Maintenance**	**14**
7.1	General instructions	14
7.2	Servicing / inspection	14
7.2.1	Supervision of operation	14
7.2.2	Lubrication and lubricant change	15
7.3	Drainage / disposal	15
7.4	Dismantling	15
7.4.1	Fundamental instructions and recommendations	16
7.4.2	Dismantling (general)	16
7.4.3	Check of wears	16
7.5	Reassembly	17
7.5.1	General instructions	17
7.5.2	Re-assembly (general) – below floor and bearing bracket lantern	17
7.5.3	Shaft seal assembly	17
7.5.4	Reassembly (general) – above floor	18
7.5.5	Tightening torques	18
7.5.6	Diametral clearances	19
7.6	Spare parts stock	19
7.6.1	Recommended spare parts stock for 2 years' operation	19
7.6.2	Interchangeability of pump components	20
8	**Troubleshooting**	**21**
9	**Sectional drawing**	**22**

Introduction

KSB has supplied you an equipment that has been designed and manufactured with the latest technology.
Due to its simple and tough construction, it will need few maintenance. With the aim to provide our clients with a satisfactory, trouble free operation, we recommend to install and care our equipment according to the instructions contained in this service manual.

This manual has been prepared to inform the end user about construction and operation of our pumps, describing the proper procedures for handling and maintenance.
We recommend that this manual should be handled by the maintenance supervision.
This equipment must be used at operation conditions for which it has been selected, such as: flow rate, total head, speed, voltage, frequency and temperature of pumped liquid.

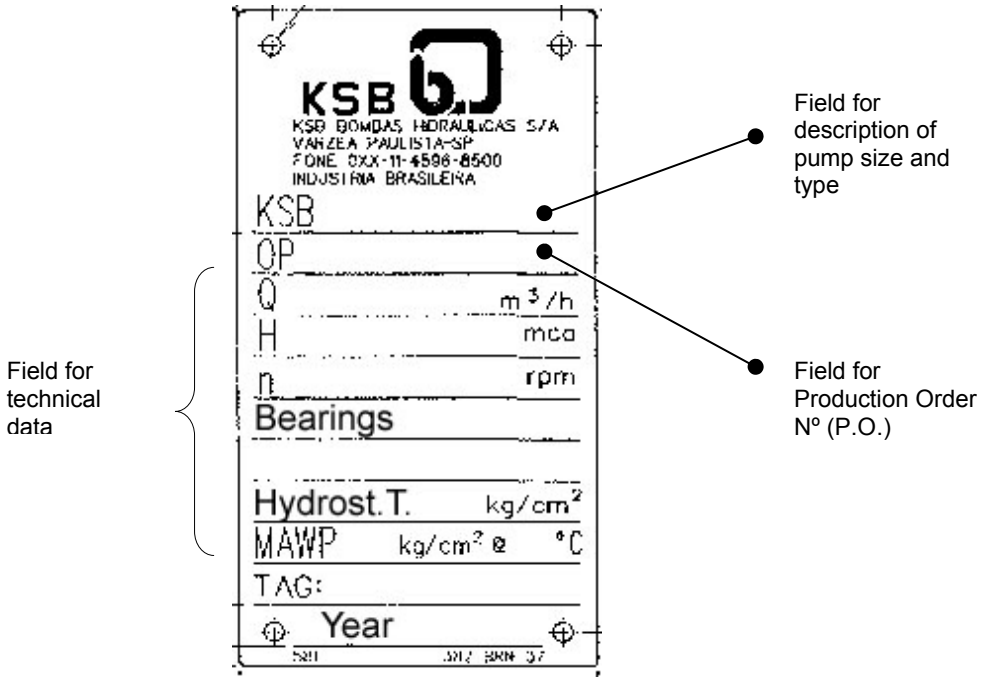


Fig. 1 - Nameplate

For requests about the equipment, or when ordering spare parts, please mention the type of the pump and the Production Order number (serial nº). This information can be obtained from the nameplate of each pump. If the nameplate is not available, the OP number is engraved in low relief on the suction flange and on the discharge flange you may find the impeller diameter.

Attention: This manual contains very important recommendations and instructions. Must be carefully read before installation, electrical connection, first start up and maintenance.

1. General

Caution This KSB product has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.
These operating instructions are intended to facilitate familiarization with the unit and its designated use.
The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the unit and to avoid any risks.
These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.
This pump / unit must not be operated beyond the limit values for the fluid handled, capacity, speed, density, pressure, temperature and motor rating specified in the technical documentation. Make sure that operation is in accordance with the instructions laid down in this manual or in the contract documentation. Contact the manufacturer, if required.
The nameplate indicates the type series / size, main operating data and works number; please quote this information in all queries, repeat orders and particularly when ordering spare parts.
If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact KSB´s nearest customer service centre.
For noise characteristics please refer to section 4.3.7.

2. Safety

These operating instructions contain fundamental information which must be complied with during installation, operation, monitoring and maintenance. Therefore this operating manual must be read and understood both by the installing personnel and the responsible trained personnel / operators prior to installation and commissioning, and it must always be kept close to the location of operation of the machine / unit for easy access.
Not only must the general safety instructions laid down in this chapter on “Safety” be complied with, but also the safety instructions outlined under specific headings, particularly if the pump / unit is operated in hazardous areas (see section 2.9).

2.1 Marking of instructions in the manual

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the symbol

general hazard sign to ISO 7000-0434

the **electrical danger warning sign** is

safety sign to IEC 417-5036

and special instructions concerning explosion protection are marked

The word

Caution

is used to introduce safety instructions whose non-observance may lead to damage to the machine and its functions.

Instructions attached directly to the machine, e.g.
- arrow indicating the direction of rotation
- markings for fluid connections

must always be complied with and be kept in a perfectly legible condition at all times.

2.2 Personnel qualification and training

All personnel involved in the operation, maintenance, inspection and installation of the unit must be fully qualified to carry out the work involved.
Personnel responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the requisite know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to take care of such training. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

2.3 Non-compliance with safety instructions

Non-compliance with safety instructions can jeopardize the safety of personnel, the environment and the machine / unit itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.

In particular, non-compliance can, for example, result in:
- failure of important machine / system functions;
- failure of prescribed maintenance and servicing practices;
- hazard to persons by electrical, mechanical and chemical effects as well as explosion;
- hazard to the environment due to leakage of hazardous substances.

2.4 Safety awareness

It is imperative to comply with the safety instructions contained in this manual, the relevant national and international explosion protection regulations, and the operator´s own internal work, operation and safety regulations.
Ex symbol relates to additional requirements which must be adhered to when the pump is operated in hazardous areas.

2.5 Safety instructions for the operator / user

- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.

- Guards which are fitted to prevent accidental contact with moving parts (e.g. coupling) must not be removed whilst the unit is operating.
- Leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons or the environment. All relevant laws must be heeded.
- Electrical hazards must be eliminated. (In this respect refer to the relevant safety regulations applicable to different countries and / or the local energy supply companies.)
- Any components in contact with the fluid pumped, especially in the case of abrasive fluids, shall be inspected for wear at regular intervals and replaced by original spare parts (see section 2.7) in due time.

If the pumps / units are located in hazardous areas, it is imperative to make sure that unauthorized modes of operation are prevented. Non–compliance may result in the specified temperature limits being exceeded.

2.6 Safety instructions for maintenance, inspection and installation work

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
The pump must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained.
Work on the machine / unit must be carried out only during standstill. The shutdown procedure described in the manual for taking the unit out of service must be adhered to without fail.
Pumps or pump units handling fluids injurious to health must be decontaminated.
Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and / or re-activated.
Please observe all instructions set out in the chapter on "Commissioning" before returning the unit to service.

2.7 Unauthorized modification and manufacture of spare parts

Modifications or alterations of the equipment supplied are only permitted after consultation with the manufacturer and to the extent permitted by the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts can invalidate any liability of the manufacturer for consequential damage.

2.8 Unauthorized modes of operation

The warranty relating to the operating reliability and safety of the unit supplied is only valid if the equipment is used in accordance with its designated use as described in the following sections. The limits stated in the data sheet must not be exceeded under any circumstances.

2.9 Explosion protection

If the pumps / units are installed in hazardous areas, the measures and instructions given in the following sections 2.9.1 to 2.9.6 must be adhered to without fail, to ensure explosion protection.

2.9.1 Unit fill

It is assumed that the system of suction and discharge lines and thus the wetted pump internals are completely filled with the product to be handled at all times during pump operation, so that an explosive atmosphere is prevented.

If the operator cannot warrant this condition, appropriate monitoring devices must be used.

Caution In addition, it is imperative to make sure that the seal chambers, auxiliary systems of the shaft seal and the heating and cooling systems are properly filled.

2.9.2 Marking

The marking on the pump only refers to the pump part, i.e. the coupling and motor must be regarded separately. The coupling must have an EC manufacturer's declaration. The driver must be regarded separately.

Example of marking on the pump part:
Ex II 2 G T1 - T5
The marking indicates the theoretically available temperature range as stipulated by the respective temperature classes. The temperatures permitted for the individual pump variants are outlined in section 2.9.5.
Pumps RPH-V are designed to meet the requirements of Zone 1 and Category 2 as per EN1127-1.

2.9.3 Checking the direction of rotation (see also 6.1.4)

If the explosion hazard also exists during the installation phase, the direction of rotation must never be checked by starting up the unfilled pump unit, even for a short period, to prevent temperature increases resulting from contact between rotating and stationary components.

2.9.4 Pump operating mode

Make sure that the pump is always started up with the suction-side shut-off valve fully open and the discharge-side shut-off valve slightly open. However, the pump can also be started up against a closed swing check valve. The discharge-side shut-off valve shall be adjusted to comply with the duty point immediately following the run-up process (see 6.1.7).
Pump operation with the shut-off valves in the suction and / or discharge pipes closed is not permitted.
Caution In this condition, there is a risk of the pump casing taking on high surface temperatures after a very short time, due to a rapid temperature rise in the pumped fluid inside the pump.
Additionally, the resulting rapid pressure build-up inside the pump may cause excessive stresses on the pump materials or even bursting.
The minimum flows indicated in section 6.2.5 refer to water and water-like liquids. Longer operating periods with these liquids and at the flow rates indicated will not cause an additional increase in the temperatures on the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check if an additional heat build-up may occur and if the

minimum flow rate must therefore be increased. To check, proceed as described in section 6.2.5.
In addition, the instructions given in section 6 of this operating manual must be observed.

Both gland packings and mechanical seals may exceed the specified temperature limits if run dry. Dry running may not only result from an inadequately filled seal chamber, but also from excessive gas content in the fluid handled.
Pump operation outside its specified operating range may also result in dry running.
In hazardous areas, gland packings shall only be used if combined with a suitable temperature monitoring device.

2.9.5 Temperature limits

In normal pump operation, the highest temperatures are to be expected on the surface of the pump casing, at the shaft seal and in the bearing areas. The surface temperature at the pump casing corresponds to the temperature of the fluid handled.
If the pump is heated, it must be ensured that the temperature classes stipulated for the plant are observed.
In the bearing bracket area, the unit surfaces must be freely exposed to the atmosphere.
In any case, responsibility for compliance with the specified fluid temperature (operating temperature) lies with the plant operator. The maximum permissible fluid temperature depends on the temperature class to be complied with.
The table below lists the temperature classes to EN 13463-1 and the resulting theoretical temperature limits of the fluid handled. In stipulating these temperatures, any temperature rise in the shaft seal area has already been taken into account.

Temperature class to EN 13463-1:	Temperature limit of fluid handled
T5	85ºC
T4	120ºC
T3	185ºC
T2	280ºC
T1	Max. 400ºC *)

*) depending on material variant

Safety note:

Caution The permissible operating temperature of the pump in question is indicated on the data sheet. If the pump is to be operated at a higher temperature, the data sheet is missing or if the pump is part of a pool of pumps, the maximum permissible operating temperature must be inquired from the pump manufacturer.
Based on an ambient temperature of 40ºC and proper maintenance and operation, compliance with temperature class T4 is warranted in the area of the rolling element bearings. A special design is required to comply with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40ºC, contact the manufacturer.

2.9.6 Maintenance

Only a pump unit which is properly serviced and maintained in perfect technical condition will give safe and reliable operation.
This also applies to the reliable function of the rolling element bearings whose actual lifetime largely depends on the operating mode and operating conditions.
Regular checks of the lubricant and the running noises will prevent the risk of excessive temperatures as a result of bearings running hot or defective bearing seals (also see section 7.2.2.1).
The correct function of the shaft seal must be checked regularly. Any auxiliary systems installed must be monitored, if necessary, to make sure they function correctly.
Gland packings must be tightened correctly, to prevent excessive temperatures due to packings running hot.

3. Transport and interim storage

3.1 Transport

The transport of motor-pump set or only pump should be made with ability and sound sense, according to safety standards. By the motor eyebolt should only lift it, never the motor-pump set.

If the pump / unit slips out of the suspension arrangement, it may cause personal injury and damage to property!

Assembled unity (Column up to 3 meters)
The unity should be transported and stored in the horizontal position.
Lifting cable should be placed only in the pump casing and drive lantern. To introduce the pump in the well, place the lifting cables in the soleplate eyebolt and lift the equipment to vertical position.

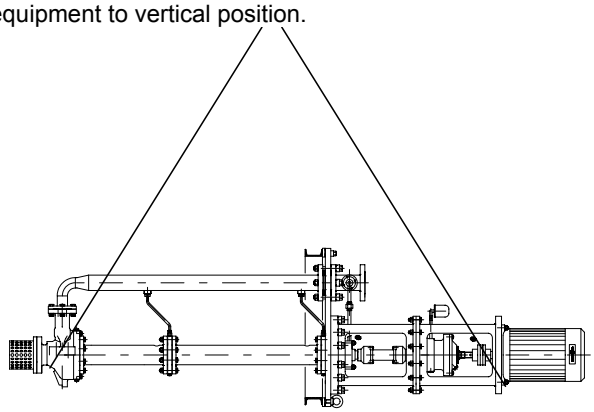


Fig. 1 - Assembled unity

Single parts (column above 3 meters)
(Pump casing, suspension piping, shaft, bearings, rising pipe).
Pump is transported partially disassembled, therefore single parts should be transported and stored in the horizontal position, except for drive lantern and soleplate.

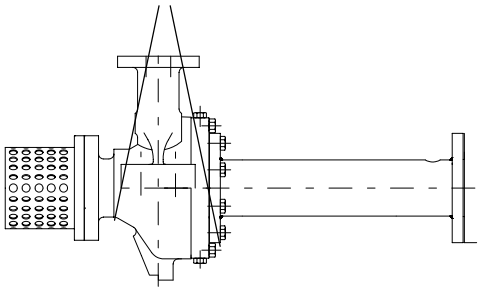


Fig. 2 - Pump casing and part of column pipe

3.2 Interim storage (indoors) / Preservation

KSB standard storage and preservation procedures maintain the pump protected for a maximum period of 6 months in a indoor installation. The unit / pump should be stored in a dry room where the atmospheric humidity is as constant as possible. When this period is exceeded, additional storage procedure should be taken. For that, please use the following conservation liquids:

- Internal parts of ferrous material in contact with pumped liquid (except mechanical seal contact surfaces): water repellent of mineral oil basis.
- Bearings: mineral oil for internal conservation.
- Polished parts: mineral oil for internal and external conservation.
- Mechanical seals: should be cleaned by dry air. Do not apply any liquid or other conservation material in order to not damage secondary sealings (O´rings and flat gaskets).

All existing connections, like plugs for external source liquid, priming, drainage, etc, should be properly covered.
Pump suction and discharge flanges are properly covered with adhesive, in order to avoid strange contents in its interior.
Assembled pumps waiting for start up or installation should have their rotor manually rotated each 15 days. In case of difficulty, use some adjustable spanner, protecting the motor shaft surface.
Before conservation liquids application, areas should be washed with gas or kerosene until they are completely cleaned.
The conservative liquids can be removed from the areas in contact with pumped liquid, polished parts and surfaces like: shaft, salient faces and couplings, by means of solvents derived from petroleum or clean industrial liquids. Drain the conservative oil from bearing bracket before fulfill it with lubricant oil.

4. Description of the product and accessories

4.1 Technical specification

Chemical shaft-driven sump pump
Fields of application:
Used in the chemical and petrochemical industry as well as in refineries for handling chemically aggressive media with low solids content.

4.2 Designation

RPH - V 40 - 180

Type series
Vertical execution
Discharge nozzle DN
Nominal impeller dia. in mm

For materials refer to the data sheet.

4.3 Design details

Vertical, radially split shaft-driven sump pump with volute casing, in wet or dry installation, single stage.

4.3.1 Pump casing

Radially split, consisting of single volute casing and casing cover.

For handling combustible media, the pump casing, the pipe assembly and the flanged elbow must be made of ductile material with a maximum magnesium content of 7.5% (see EN 13463-1). This is a standard feature in all KSB supplies.

4.3.2 Impeller form

Closed radial impeller with multiply curved vanes. Axial thrust is balanced by means of suction and discharge-side casing wear rings and balancing holes.

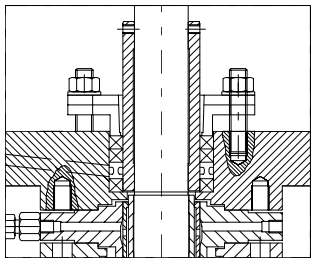
4.3.3 Shaft seal

Shaft sealing is effected by gland packing (special variant) or single or double acting mechanical seals.
The shaft seal is located in a replaceable stuffing box housing and can be removed and re-installed without having to dismantle the pump.

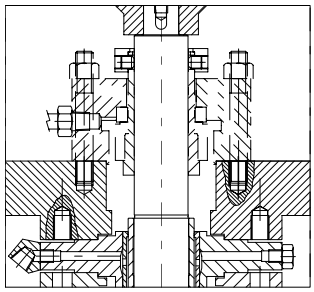
Caution It is recommended to use sealing plans with an external source (plans 32,52,53,54) to lubricate the mechanical seal faces in order to avoid dry run during start-up.
For other sealing plans and gland packing applications consult KSB.

Arrangement drawing (examples)

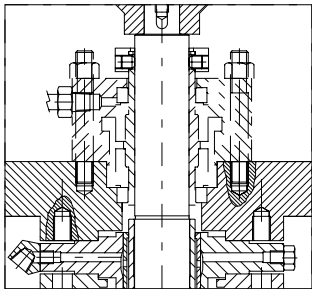
Gland packing



Mechanical seal



Mechanical seal single-acting



Mechanical seal double-acting

4.3.4 Bearings

The shaft assembly is fixed in axial direction by means of a deep groove ball bearing. The bearing can be oil or grease lubricated.
In the volute casing and in the pipe assemblies the shaft is supported in plain bearings lubricated by the pumped liquid. If contaminated fluids are handled, the bearings can be lubricated from an external source via a lubricating line (special design).

4.3.5 Permissible forces and moments at the discharge nozzle

RPH-V pumps are designed in such way that they can withstand piping forces and moments acc. to API 610.
The data on forces and moments apply to static pipelines only. If the limits are exceeded, they must be checked and verified.
The values are only applicable if the pump is installed on a completely grouted soleplate.

4.3.6 Noise characteristics

Rated power input P_N (kW)	Sound pressure level $\overline{L}$ pA (db) ① ②					
	Pump only			Pump with motor		
	2900 1/min	1450 1/min	960/760 1/min	2900 1/min	1450 1/min	960/760 1/min
1.5	53.5	51.5	50.5	62.5	57.0	55.5
2.2	55.5	53.5	52.5	65.0	59.5	57.5
3.0	57.0	55.5	54.0	67.0	61.0	59.0
4.0	58.5	57.0	55.0	68.5	62.5	60.5
5.5	60.5	58.5	56.5	70.0	64.5	62.0
7.5	62.0	60.0	58.0	71.5	65.5	64.0
11.0	64.0	62.0	60.0	73.5	67.5	65.5
15.0	65.5	63.5	61.5	74.5	69.0	67.0
18.5	66.5	65.0	62.5	75.5	70.0	68.0
22.0	67.5	66.0	63.5	76.0	70.5	68.5
30.0	69.0	67.5	65.0	77.0	71.5	69.5
37.0	70.0	68.5	66.0	77.5	72.0	70.5
45.0	71.0	69.5	66.5	78.5	73.0	71.5
55.0	72.0	70.5	67.5	79.0	74.0	72.0
75.0	74.0	72.0	69.0	79.5	75.0	73.0
90.0	75.0	73.0	70.0	80.0	75.5	74.0
110.0	76.0	74.0	71.0	80.5	76.0	74.5

① Measured at a distance of 1m from the pump outline (as per DIN 45635 Part 1 and 24). Room and foundation influences have not been included. The tolerance for these factors is 1 to 2 dB.

② Increase for 60 Hz operation
Pump without motor: ---
Pump with motor:
3500min-1:+3dB, 1750min-1: + 1dB, 1160min-1: ---dB

4.3.7 Technical data table

Pump Size		Unity	25-180	25-230	40-180	40-230	50-200	80-200	40-181	40-231	40-280	40-281	40-361	50-180
Volute type		- -	Simple											
Impeller	- Outlet width	mm	6	6	6	6.2	10,5	14	7.8	7.7	7.5	7.7	7.9	10.9
	- Inlet diameter		48	48	58	57	88	105	75	75	61	71	69	88
	- Impeller maximum diam.		179	224	180	224	205	207	180	230	278	278	343	180
Sealing chamber size (Acc.to API 682 Table 1)		--	4											
Bearing			6313											
Shaft diameter	- in the sealing chamber (D)	mm	50											
	- in the bearing		65											
	- in the coupling		32											
	- in the impeller		24						27					
Driver	- Maximum Value P/n[1)]	kW / rpm	0.019						0.0321					
Motor maximum power	n = 1450 rpm	kW	28						47					
	n = 1750 rpm		33						56					
	n = 2900 rpm		55						93					
	n = 3500 rpm		67						112					

1) The indicated values are for shaft material A434 4140 CL.BB and impeller in A216WCB & temperature < 100ºC. For other condition, please consult KSB.

4.4 Accessories

Coupling: flexible coupling
If a complete unit is supplied, coupling and coupling guard are provided by the supplier.
Special accessories: as required

4.5 Dimensions and Weights

For dimensions and weights please refer to the general arrangement drawing of the pump.

5. Installation at site

Pumps should be installed, leveled and aligned by qualified people. When this service is inappropriate executed, it can have as consequence, operation troubles, premature wear and irreparable damage.

Foundation Plan drawing (FU) informs pump dimension, weights, foundation arrangement, connection sizes and position of fixation elements.

Assure that all parameters for handling and operation (access, assembly area, connections for assembly equipment, cranes, etc) were perfectly established before pump installation activities.

5.1 Safety regulations

Equipment operated in hazardous locations must comply with the relevant explosion protection regulations. This is indicated on the pump name plate and motor name plate (see 2.9).

5.2 Checks to be carried out prior to installation

All structural work required must have been prepared in accordance with the dimensions stated in the dimension table / general arrangement plan.

In case of concrete foundations they shall have sufficient strength (min.class X0) to ensure safe and functional installation in accordance with DIN 1045 or equivalent standards.
Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface shall be truly horizontal and even. The foundation bolts shall be inserted in the soleplate.

5.2.1 Place of installation

The volute casing, the pipe assembly and certain areas of the soleplate take on roughly the same temperatures as the medium handled. The motor stool or bearing bracket lantern must not be insulated.
Take the necessary precautions to avoid burns.

5.3 Soleplate foundation, settle and leveling

Place foundation rail in the trench done in the foundation block in accordance with Foundation Plan dimensions.
The foundation rail leveling should be executed with a precision level instrument, and kept smaller than 0,1 mm/meter since its not recommended to place chock blocks which would injure soleplate tightness. After complete mortar cure it should executed an appropriate cleaning and removed concrete sparkling from foundation rail. Place the gasket and soleplate over foundation block and fix it.
Note: The tightness of the well can affect the $NPSH_A$ due to atmospheric pressure absence. The user should assure that $NPSH_A$ is higher than $NPSH_R$ at least 1,0 meter.

Check if soleplate is uniform arranged on the foundation rail.

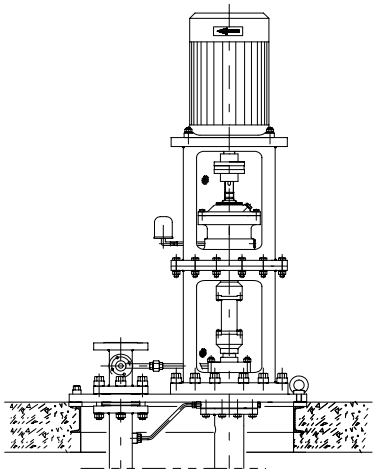


Fig. 3 - Soleplate settle

5.4 On a nozzle of a pressure vessel

In this case the pump set is supplied on a flange that will cover / close the tank vessel.
Normal procedures recommended for flange connection should be applied i.e. parallelism between the contact faces smaller than 0,5 mm and leveling deviation smaller than 0,1 mm/meter.

5.5 Aligning the pump / drive

The pump unit consisting of pump, coupling and drive has been mounted on a common baseplate and carefully aligned in the manufacturing works.
The following instructions also apply to units not mounted on a common baseplate.

Caution After connecting the piping and priming the system, it is essential to re-check the alignment at operating temperature.

Caution Incorrect alignment and inadmissible coupling displacement will affect the operating behavior and may result in damage to the bearings and shaft seals as well as premature coupling wear.

Please note:
The pump set is correctly aligned, if a straight-edge placed axially on both coupling halves is the same distance from each shaft at all points around the circumference. In addition, the distance between the two coupling halves must remain the same all around the circumference. Use a feeler gauge, a wedge gauge or a dial micrometer to verify (see figs. 4 and 5).

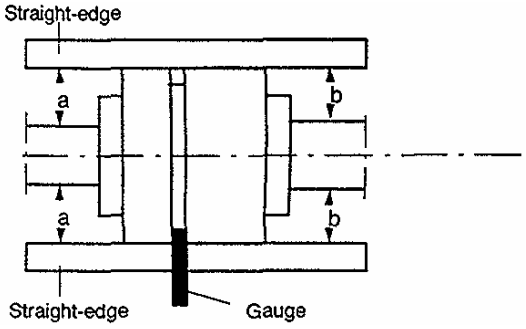


Fig. 4 - Aligning the coupling with the help of a gauge and a straight-edge

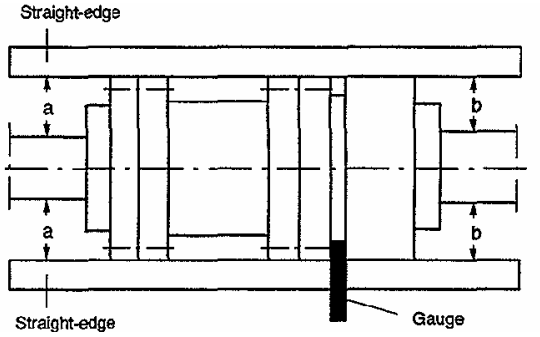


Fig. 5 - Aligning a spacer-type coupling

The radial and axial deviation between the two coupling halves must not exceed 0.1 mm.

The alignment of the pump and drive shall preferably be checked by means of a dial micrometer. For this purpose remove the coupling spacer after having marked its installation position by dotting marks (balancing condition).
At the same time check the motor´s direction of rotation, with the pump decoupled (see 6.1.4). The direction of rotation must correspond to the direction indicated by the arrow on the pump. Verify by switching the motor on and then off again immediately. Fig. 6 illustrates examples of possible dial micrometer arrangements.

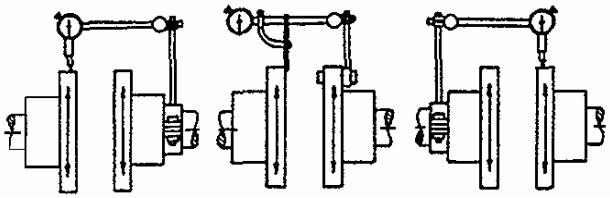


Fig. 6 - Aligning a spacer-type coupling with a dial Micrometer

Admissible run-out of coupling face (axial) max. 0.1 mm.
Admissible radial deviation, measured over the complete circumference, max. 0.2 mm.

5.5.1 Aligning the complete unit

To align the complete unit, undo bolt 901.4 and fixing bolts 901.61 on the assembling aid (if any).
Undo pump fastening elements and align pump and motor. (Compensate for any differences in height between pump and motor by means of approximately sized sheet packs under the feet of the drive). On pump units with larger motors, horizontal motor alignment shall be effected by means of alignment devices). Re-tighten the bolts on the pump foot and the motor bolts.
If any, tighten fixing bolts 901.61 as well as bolt 901.4 and re-check alignment. For subsequent alignment at operating temperature proceed in the same way.
If other couplings are used, please refer to the enclosed supplementary operating instructions.

5.6 Connecting the piping

Caution Never use the pump itself as an anchorage point for the piping. The permissible pipeline forces must not be exceeded (see section 4.3.5).
The pipelines shall be anchored in close proximity to the pump and connected without transmitting any stresses or

strains. The nominal diameters of the pipelines shall be at least equal to the nominal diameters of the pump nozzles. It is recommended to install check and shut-off elements in the system, depending on the type of plant and pump. It must be ensured, however, that the pump can still be drained and dismantled without problems.
Thermal expansions of the pipelines must be compensated by appropriate measures so as not to impose any extra loads on the pump exceeding the permissible pipeline forces and moments.

An excessive, impermissible increase in the pipeline forces may cause leaks on the pump where the fluid handled can escape into the atmosphere.
Danger of life when toxic or hot fluids are handled.
The flange covers on the pump suction and discharge nozzles must be removed prior to installation in the piping.

Caution After the piping has been connected, it must be easy to rotate the pump shaft by hand at the coupling.

Recommendations for suction

In the pump installation, please consider the following conditions:
a) Check minimum distance from bottom well up to suction outlet or strainer according to installation (see foundation plan).

b) Check liquid minimum level above pump casing, in order to avoid dry operation, cavitation or vortex.

c) In case of frequent liquid level variation, it should foreseen the installation of protection system against operation below the minimum level.

d) In case of liquid with solids in suspension or with excessive dirty, it should foreseen strainer in the pump inlet.

Recommendations for discharge piping

The discharge piping assembly should comply with the following considerations:
a) It should have disposals for water hammer control, every time the overpressure values, deriving from liquid return in long pipings, exceeds the recommended values for piping and pump.

b) In the points where it is necessary to extract the air it should foreseen vent valves.

c) It is necessary to foreseen tie bolted assembly joints, to absorb system reaction efforts, deriving from applicable loads.

d) Safety valves, relief disposals and other operation valves, besides those mentioned, should foreseen when necessary.

5.6.1 Auxiliary connections

The dimensions and locations of the auxiliary connections (cooling, barrier liquid, flushing liquid, etc.) are indicated on the general arrangement drawing or piping layout.

Caution These connections are required for proper functioning of the pump and are therefore of vital importance!

5.6.2 Contact Guard

In compliance with the accident prevention regulations the pump must not be operated without a contact guard.
If the customer specifically requests not to include a contact guard in our delivery, then the operator must supply one. In this case, it is important to make sure that the materials selected for coupling and coupling guard are non-sparking in the event of mechanical contact. KSB's scope of supply meets this requirement.

5.7 Final check

Re-check the alignment as described in section 5.3 and verify the correct distance between the coupling and the coupling guard.
It must be easy to rotate the shaft by hand at the coupling.

5.8 Connection to power supply

Connection to the power supply must be effected by a trained electrician only. Check available mains voltage against the data on the motor rating plate and select appropriate start-up method.
We strongly recommend to use a motor protection device (motor protection switch).
In hazardous areas, compliance with IEC60079-14 is an additional requirement for electrical connection.

6. Commissioning, start-up / shutdown

Caution Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance shall not be covered by the scope of warranty.

6.1 Commissioning

Before starting up the pump make sure that the following requirements have been checked and fulfilled.
If a constant-level oiler is provided, screw same into the tapping hole provided in the bearing bracket prior to adding the oil (see 6.1.1).
The connection between bearing bracket and constant-level oiler shall be sealed with PTFE tape, if necessary.
The operating data, the oil level, if applicable (6.1.1), and the direction of rotation (6.1.4) must have been checked.
The pump must have been primed (6.1.3).
Also verify the following:
- Make sure that the unit has been properly connected to the electric power supply and is equipped with all protection devices.
- Make sure that all auxiliary lines (5.4.1) are connected and functioning.
- If the pump has been out of service for a longer period of time, proceed in accordance with section 6.4.

6.1.1 Lubricants

Oil lubricated bearings

The bearing bracket has to be filled with lubricating oil. The oil quality required is outlined in section 7.2.2.3 and the quantity in section 7.2.2.4.

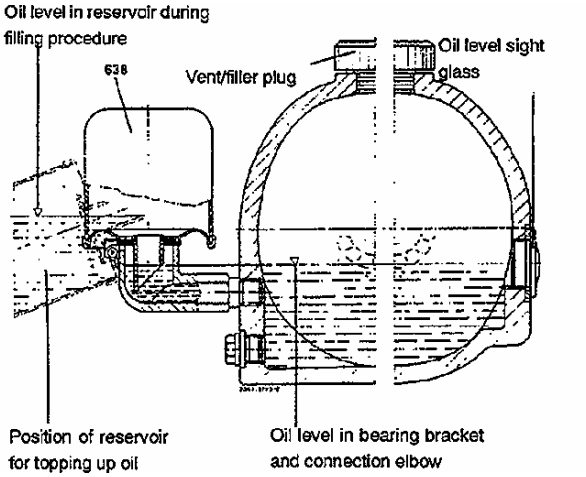

Oil level in reservoir during filling procedure
638
Vent/filler plug
Oil level sight glass
Position of reservoir for topping up oil
Oil level in bearing bracket and connection elbow

Fig. 7 - Oil fill

Procedure:
Remove the protective cage of the constant-level oiler. Unscrew vent plug. Pour in the oil through the vent plug tapping hole after having hinged down the reservoir of the constant-level oiler until oil appears in the vertical portion of the connection elbow (Fig 7).
Then fill the reservoir of the constant-level oiler with oil and snap it back into operating position. Screw vent plug in again. After a short time check whether the oil level in the reservoir has dropped. It is important to keep the reservoir properly filled at all times!
If access to the vent plug is difficult or impossible, e.g. in cases where the motor is arranged above the pump (piggy-back arrangement), the oil can be filled in through the connection elbow of the constant-level oiler.

Caution The oil level shall always be below the level of the vent opening arranged at the top edge of the connection elbow.

During pump standstill the oil level can be checked at the oil level sight glass.

Grease lubricated bearings

This option provides a bearing sealed on both sides and lubricated for life with a special grease (ref. SKF – GJN). For replacements consider this characteristic.

6.1.2 Shaft seal

Caution Gland packings supplied with the pump have to be installed prior to pump startup (unless they were fitted prior delivery).
The gland packing must be tightened gently and evenly.
It must be easy to rotate the shaft by hand.

Caution The mechanical seal has been fitted prior to delivery. On variants with quench supply tank, the tank must be fitted in accordance with the general arrangement drawing (see also 6.1.3). Quench feed must also be provided during pump shutdown. On variants with pressurized dual mechanical seals, apply barrier pressure as specified in the general arrangement drawing prior to starting up the pump (see 6.1.3). Barrier pressure must also be provided during pump shutdown.

Caution For external liquid supply, the quantities and pressure specified in the data sheet and general arrangement drawing shall be applied.

6.1.3 Priming the pump and checks to be carried out

Before start-up, the pump, suction line and thermosyphon vessel, if any, must be vented and primed. The shut-off valve in the suction line must be fully open.
Fully open all auxiliary lines provided (flushing, barrier, cooling liquid, etc.) and check the throughflow.
For water cooling, use suitable non-aggressive cooling water not liable to form deposits and not containing suspended solids. (Hardness: on average 5dH; (~1 mmol/l); pH > 8, or conditioned and neutral with regard to mechanical corrosion).
Inlet temperature t_E = 10 to 30ºC
Outlet temperature t_A max. 45ºC

Caution **Dry running of the pump will result in mechanical seal failure and must be avoided!**

6.1.3.1 Cooling

Caution In general, the shaft seal must be cooled if the vaporization pressure of the fluid handled is higher than the atmospheric pressure. Depending on the fluid handled, the system pressure and the mechanical seal material, the limit may change (example: hot water).

Caution Ex Observe permissible temperature classes.

6.1.4 Checking the direction of rotation

When the unit has been connected to the electric power supply, verify the following (local and national regulations have to be taken into account separately):

Caution For trouble-free operation of the pump, the correct direction of rotation of the impeller is of paramount importance. If running in the wrong direction of rotation, the pump cannot reach its duty point; vibrations and overheating will be the consequence. The unit or the shaft seal might be damaged.

Correct direction of rotation:
The direction of rotation must correspond to the direction indicated by the arrow on the pump.
Never put your hands or any other objects into the pump.

Caution Ex The motor's direction of rotation must be checked with the pump/motor coupling removed.
If the motor runs in the wrong direction of rotation, interchange two of the three phases in the control cabinet or motor terminal box.
The safety instructions set forth in section 2.9.3 must be complied with.

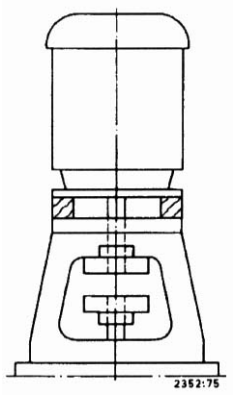


Fig. 8 – Decoupled drive

6.1.5 Cleaning the sump or pressure vessel

The cleaning operation mode and duration for flushing and pickling service must be matched to the casing and seal materials used.

6.1.6 Start-up

Before starting the pump ensure that the shut-off element in the suction line (if any) is fully open.
The pump may be started up against a closed discharge-side swing check valve or slightly open shut-off valve. Only after the pump has reached full rotational speed shall the shut-off valve in the discharge line be opened slowly and adjusted to comply with the duty point. When starting up against an open discharge-side shut-off valve, take the resulting increase in input power into account!

Caution Pump operation with the shut-off valves in the discharge and suction pipes closed is not permitted.
The permissible pressure and temperature limits might be exceeded. In extreme cases, the pump may burst.

Caution After the operating temperature has been reached and / or in the vent of leakage, switch off the unit and re-tighten the bolts between volute casing and casing cover. Permissible tightening torques see 7.5.3.

Caution Check the coupling alignment at operating temperature as described in section 5.3.1 and re-align, if necessary.

Immediate steps after start up

After start up and with pump in process, please observe the following items:

a) Control electric power consumption (amperage) and voltage;

b) Certify that the pump runs free of vibration and abnormal noises;

c) Control support bearing temperature, which can reach up to 40ºC above ambient temperature, however the sum of them can not exceed 82ºC.

The above items should be controlled each 15 minutes during the first 2 hours operation. If everything is normal, new controls should be made each 1 hour, during the first 5 up to 8 hours. If there is anything abnormal during this period, please consult chapter Functioning Abnormalities and its eventual Causes.

6.1.7 Shutdown

Close the shut-off valve in the discharge line.
If the discharge line is equipped with a non-return or check valve, the shut-off valve may remain open. If shut-off is not possible, the pump will run in reverse direction.

Caution This may cause damage to mechanical seals which are not bi-directional!

The reverse runaway speed must be lower than the rated speed.
Switch off the drive, making sure that the unit runs down smoothly to a standstill.
Close the auxiliary lines but do not turn off the cooling liquid supply, if any, until the pump has cooled down.
Please refer to section 6.1.2!
In the event of frost and / or prolonged shutdowns, the pump – and the cooling chambers, if any – must be drained or otherwise protected against freezing.

6.2 Operating limits

The pump´s / unit´s application limits regarding pressure, temperature and speed are stated on the data sheet and must be strictly adhered to!
If a data sheet is not available, contact KSB!

6.2.1 Temperature of the fluid handled, ambient temperature, bearing temperature

Caution Do not operate the pump at temperatures exceeding those specified on the data sheet or the name plate unless the written consent of the manufacturer has been obtained. Damage resulting from disregarding this warning will not be covered by the KSB warranty.
Bearing bracket temperature see 7.2.1.

The safety instructions set forth in section 2.9 must be complied with.

6.2.2 Switching frequency

To prevent high temperature increases in the motor and excessive loads on the pump, coupling, motor, seals and bearings, the switching frequency shall not exceed the following number of start-ups per hour (S).

Motor rating (kW)	max. S (start –ups / h)
up to 12	15
up to 100	10
more than 100	5

If the above switching frequencies are exceeded, please contact the motor manufacturer or KSB.

6.2.3 Density or fluid pumped

The power input of the pump will increase in proportion to the density of the fluid pumped. To avoid overloading of the motor, pump and coupling, the density of the fluid must comply with the data specified on the purchase order.

6.2.4 Abrasive fluids

When the pump handles liquids containing abrasive substances, increased wear of the hydraulic system and

the shaft seal are to be expected. The intervals recommended for servicing and maintenance shall be shortened.

6.2.5 Minimum / Maximum flow

For max. flow Q_{max} please refer to the characteristic curves. Unless other limits are specified in the characteristic curves or data sheet, the minimum flow for
50 Hz and ρ = 1.2 kg / dm^3
60 Hz and ρ = 1.0 kg / dm^3
is $Q_{min} = 0.3 \times Q_{opt}$
Q_{opt} = optimum efficiency
The data refer to water and water-like liquids. However, if the physical properties of the fluids handled are different from water, the calculation formula below must be used to check if an additional heat build-up may lead to a dangerous temperature increase at the pump surface. If necessary, the minimum flow must be increased.

$$T_o = T_f + \Delta\vartheta$$

$$\Delta\vartheta = g * H / c * \eta * (1 - \eta)$$

c	Specific heat	[J / kg K]
g	Acceleration due to gravity	[m / s^2]
H	Pump head	[m]
T_f	Temperature of fluid handled	[ºC]
T_o	Temperature of casing surface	[ºC]
η	Pump efficiency at duty point	[-]
$\Delta\vartheta$	Temperature difference	[ºC]

6.3 Shutdown / storage / preservation

Each KSB pump leaves the factory carefully assembled. If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump storage.

6.3.1 Storage of new pumps

- New pumps are supplied by our factory duly prepared for storage. Maximum protection for up to 6 months, if the pump is properly stored indoors.
- Store the pump in a dry location.
- Rotate the shaft by hand once a month.

6.3.2 Measures to be taken for prolonged shutdown

1. **The pump remains installed; periodic check of operation**
   In order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area, start up the pump set regularly once a month or once every 3 months for a short time (approx. 5 minutes) during prolonged shutdown periods.
   Prior to an operation check run ensure that there is sufficient liquid available for operating the pump.
2. **The pump is removed from the pipe and stored**
   Before putting the pump into storage, carry out all checks specified in sections 7.1 to 7.4. Then apply appropriate preservatives:
   - Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative. Spray the preservative through the suction and discharge nozzles. It is advisable to close the pump nozzles (e.g. with plastic caps or similar).

6.4 Returning to service after storage

Before returning the pump to service, carry out all checks and maintenance work specified in sections 7.1 and 7.2.
In addition, the instructions laid down in the sections on " Commissioning " 6.1) and " Operating Limits " (6.2) must be observed.

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and / or re-activated.

7. Servicing / maintenance

7.1 General Instructions

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump with a minimum of maintenance expenditure and work.

Work on the unit must only be carried out with the electrical connections disconnected. Make sure that the pump set cannot be switched on accidentally (danger to life!).

Pumps handling liquids posing health hazards must be decontaminated. When draining the fluid see to it that there is no risk to persons or environment or the environment. All relevant laws must be adhered to (danger to life)!

7.2 Servicing / inspection

7.2.1 Supervision of operation

Caution The pump must run quietly and free from vibrations at all times.
The pump must never be allowed to run dry.
Always ensure a sufficient liquid level above the pump inlet.
Prolonged operation against a closed shut-off valve is not permitted. When operating the pump set with the shut-off valve in the discharge line slightly open for a short period of time, the permissible pressure and temperature limits must not be exceeded.
A special design is required to comply with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40ºC, contact the manufacturer.
Verify correct oil level as described in section 6.1.1.
The shut-off elements and the auxiliary feed lines must not be closed during operation.
Any stand-by pumps installed shall be started up regularly, e.g. once a week, to keep them operational. Attention shall be paid to the correct functioning of the auxiliary connections. The cooling system must be thoroughly cleaned at least once a year to ensure proper cooling. Take the pump out of service for this purpose.
Caution If the flexible coupling elements begin to show signs of wear, they must be replaced in due time. Re-align the coupling as described in section 5.3.1.

Supervision during Operation

Depending on the labor availability and pump responsibility, we recommend the following checks, and in case of any abnormality the maintenance responsible should be advised immediately.

Weekly Supervision
Check:

a) Pump operation point;

b) Motor current consumption and net tension value;

c) Vibration and abnormal noises;

d) Bearing housing temperature.

Monthly Supervision
Check:

a) Grease change interval, (if applicable).

Semestral Supervision
Check:

a) Soleplate and motor fix bolts;

b) Pump-motor set alignment;

c) Coupling lubrication (when applicable).

Annual Supervision
Disassemble the pump for maintenance. After cleaning, inspect bearings, (do it in detail), retainers and / or bearing sealings, joints, O´rings, impeller, split casing internal regions (control also thickness), wear areas and coupling.

Note:
In installations with good operation conditions and pumped liquid not aggressive to the pump materials, the supervision can be done each 2 years.

7.2.2 Lubrication and lubricant change

7.2.2.1 Lubrication

The rolling element bearings are lubricated with mineral oil or grease for life. The guide bearings are lubricated with the pumped fluid. The lubricant change intervals as well as the required quantity and quality are specified below.

7.2.2.2 Oil change (operating hours)

Temperature at the bearing	First oil change after .... operating hours	All subsequent oil changes after.... operating hours
up to 70 ° C	300	8500 *)
70 ° C - 80° C	300	4200 *)
80° C - 90° C	300	2000 *)

*) at least once a year

Procedure:
Remove screwed plug below the bearing bracket and drain off the oil. After drainage of the bearing bracket, screw in the plug again and fill with fresh oil as described in section 6.1.1.

Caution Please observe the local laws applicable to the disposal of such substances.

7.2.2.3 Oil quality

Designation	Lubricating oil CLP46 DIN 51517 or HD 20W/20 SAE
Symbol to DIN 51502	□
Kinematic viscosity at 40 ° C	46 +/- 4 mm^2/s
Flash point (to Cleveland)	+ 175 ° C
Solidification point (pour point)	- 15 ° C
Application temperature *)	higher than permissible bearing temperature

*) For ambient temperatures below – 10° C another suitable lubricating oil type must be used.
Request particulars.

7.2.2.4 Oil quantity: 0,75 l.

7.2.2.5 Guide bearings

In the volute casing and the pipe assemblies the shaft is guided by plain bearings lubricated by the pumped liquid. Periodically, user should check and clean the small holes of lubricating pipes to the column bearings and mechanical seal.

Caution The small holes should not be clogged !!

If the pumped liquid is contaminated, the bearings are lubricated from an external source via a lubricating line (special design).

7.3 Drainage / disposal

Caution If the pump was used for handling liquids posing health hazards, see to it that there is no risk to persons or the environment when draining the fluid. All relevant laws must be heeded. If required, wear safety clothing and a protective mask!
If the fluids handled by the pumps leave residues which might lead to corrosion when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, then the unit must be flushed through, neutralized, and then for drying purposes anhydrous gas must be blown through the pump.
The flushing fluid used and any liquid residues in the pump must be properly collected and disposed of without posing any risk to persons or the environment.

7.4 Dismantling

Before dismantling the pump, secure it so as to make sure it cannot be switched on accidentally. The shut-off valve in the discharge line must be closed.

The pump set must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained including oil of bearing housing, if any.
Dismantling and reassembly must always be carried out in accordance with the relevant sectional drawing.

7.4.1 Fundamental instructions and recommendations

Repair and maintenance work to the pump must only be carried out by specially trained personnel, using **original spare parts** (see 2.7).
Observe the safety regulations laid down in section 7.1. Any work on the motor shall be governed by the specifications and regulations of the respective motor supplier.
Dismantling and reassembly must always be carried out in accordance with the relevant general assembly drawing. The general assembly drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general assembly drawing.
In case of damage you can always contact our service departments.

7.4.2 Dismantling (general)

Disconnect the auxiliary piping (if any) and remove the pump set and soleplate or flange from the sump or tank. Put it on the horizontal position. Remove coupling guard.
Disconnect the coupling and remove the motor. Extract the half coupling of pump shaft, loosening the sleeve fixing bolt before. Take out the key (940.1).

Remove the motor loosening it from the drive lantern (341). Extract the washer (920.17), unfastening the soleplate (893) from the foundation rail (89-8). Remove the pump from well and leave it in the horizontal position.

Take out the constant oil level (638) and piping (710.7), if any.
Remove the drive lantern (341) from bearing bracket lantern (344), loosening the bolts (901.9).

Extract the adjust nut (923.2).
Loosen the bolts (901.3) that fasten the bearing cover (360), and remove it.

Extract the center sleeve (526), with the bearing (321), using an extractor. Remove the key (940.2).
Loosen the bolts (901.11) to separate the drive shaft (213) and intermediary coupling (848).
Loosen the bolts (901.5) and remove the bearing casing (350).
Loosen the nuts (920.13) and take out the mechanical seal (433).
For gland packing, undo hex. nuts 920.13 and take off gland cover 452.
Remove packing rings 461, lantern ring 458 (if any) and the packing rings behind the lantern ring from stuffing box housing 451.02.
Remove the bearing bracket lantern (344) from the soleplate (893) or flange, loosening the nuts (920.17) and studs (902.17).

This action depends on seal plan piping / tubing arrangement. Check before if any piping / tubing will collide with it and remove them previously.

Remove the pipings (710), disconnecting them from their connections (720).

Remove the rise piping (711) and discharge curve (144) loosening the nuts (920.19) and bolts (901.33), respectively.

Before loosening the suspension piping (713.1) from soleplate (893) or flange, sustain the pump on a piece of wood. Remove the nuts (920.18) and loosen the soleplate with auxiliary of a crane.
Loosen the suspension piping (713.1) with the spider bearings (383). Proceed removing the suspension piping (731), extracting the intermediary shaft (212) and the pump shaft (211) which are coupled together with a split coupling (853). Remove the bearing sleeves (529) from the shaft, which are radially fixed by means of grub screws (904).
Separate the volute casing (102) from pressure cover (163) and remove pump shaft (211), together with the impeller (230).
Take out spiral wound gasket (411.31), loosen impeller nut (922) and remove impeller (230), together with gaskets (411).
Remove the key (940.5), the seal ring (400.33) and the shaft protective sleeve (524).
If it is necessary to disassemble the bearing bush (545.27) of pressure cover (163) use an extractor. The bearing bush (545) of spider bearing (383) can be removed by means of a press.

7.4.3 Check of wears

Impeller

Check damage caused to impeller due to corrosion, cavitation or erosion, and if necessary replace the impeller. When the clearance between the impeller and casing wear rings reach the double of specified value, replace them.

Bearings (Column and thrust)

Do not use disassembled rolling bearings again. Use only specified bearings.
The clearances between the bearing sleeves (529), shaft protective sleeve (524) and bearing bush (545) can not exceed the values of **0,17 mm up to 0,3 mm**. If exceeding these values these parts should be changed. Please observe methods of fixation of the bushes indicated on cross sectional drawing. For certain bush materials are necessary a bonding agent and grub screws due to shrink characteristic.
Eventual machining in the sleeves can also be done, in order to eliminate superficial defectives, since the clearance is maintained.

Shaft Sealing

Check damage at shaft protective sleeve and if it is possible, machine it, if not, it is necessary to replace it. Check damage of mechanical seal rotative and stationary faces and if necessary re-lapping or replace them.

Sealings

Check damages in the O'rings and substitute them if necessary.
Substitute the flat gasket, O´rings and spiral wound gasket. Certify that the new parts have the same size and thickness of the old ones.

Note: In case of column above 3 meters, the pump should be disassemble at the sump in the sequence already described.

7.5 Reassembly

7.5.1 General instructions

The pump shall be reassembled in accordance with the rules of sound engineering practice.
Clean all dismantled components and check them for signs of wear. Verify the dimensions given in section 7.5.5. Damaged or worn components are to be replaced by **original spare parts**. Make sure that the seal faces are clean and that the sealing elements are properly fitted.
Always use new sealing elements (O-rings / gaskets) whenever the pump is reassembled. Make sure that new gaskets have the same thickness as the old ones.
Gaskets made of graphite or other asbestos-free materials must always be fitted without using lubricants such as copper grease or graphite paste.
Avoid the use of mounting aids as far as possible. Should a mounting aid be required after all, use a commercially available contact adhesive (e.g. “Pattex”). The adhesive shall only be applied at selected points (3 to 4 spots) and in thin layers.
Do not use cyanoacrylate adhesives (quick-setting adhesives)! If in certain cases mounting aids or anti-adhesives other than described herein are required, please contact the sealing material manufacturer.

Caution **All graphite gaskets must only be used once!**

Never use O-rings that have been glued together from material sold by the metre.

Caution Do no coat O-rings with graphite or similar products. Use animal fats or silicone-base or PTFE-base lubricants instead. O-rings made of ethylene propylene shall only be coated with silicone grease or soft soap; never use mineral oils or greases!

The locating surfaces of the individual components must be coated with graphite or similar before reassembly. The same applies to screwed connections.

7.5.2 Reassembly (general) – below floor and bearing bracket lantern

Assemble the shaft protective sleeve (524), the sealing ring (400.33), the key (940.5), the impeller (230), gaskets (411) and impeller nut (922) at the pump shaft (211).

NOTE:

1) Change at every assembly the flat gaskets (400) and O’ring (412).
2) The impeller nut (922) has the fixing system “heli-coil”. For safety, KSB recommends replacement of it each 3 or 4 disassembles.

Place the pump shaft set (211) in the spiral casing (102). Place the pressure cover (163) with spiral wound (411.31).
Assemble successively, the suspension piping (713.2), the bearing sleeve (529.21) and bearing spider (383.21).

Flush off the intermediary shaft (212) against the pump shaft (211) with placed split rings (501). Fix them with split coupling (853) and studs (902.22).
Fasten the bearing bracket lantern (344) on the soleplate (893) or flange.
Place the suspension piping (713.1) and bearing spider (383.15), fixing them to the bearing bracket lantern (344) and to the suspension piping (713.2).
Fix the rising pipe (711) on the soleplate or flange. Connect the pipings (700) to the fittings (720).

7.5.3 Shaft seal assembly

Check the correct variant and proceed as below.

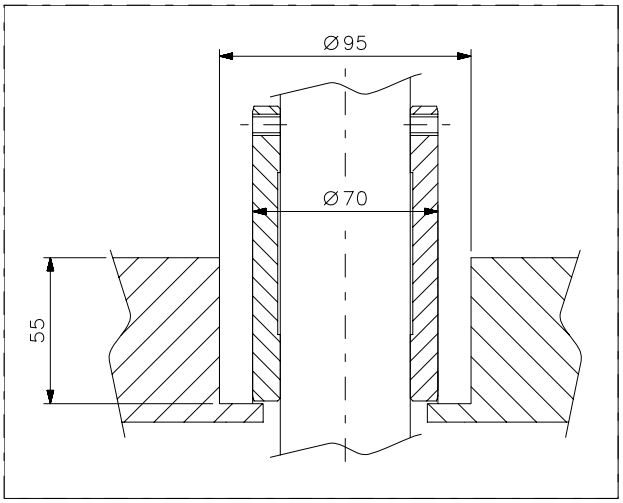
7.5.3.1 Mechanical seal installation

The following rules must be observed when mounting the mechanical seal:
Extreme care and cleanliness during assembly are of overriding importance for trouble-free operation of the mechanical seal.
The protective wrapping of the contact faces shall only be removed immediately before assembly takes place.
After inserting the seat ring, check whether it is plane-parallel in relation to the casing part. (Max. deviation: 0.02 mm).
The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve’s mounting edge must be chamfered. When sliding the rotating unit onto the shaft protecting sleeve, take appropriate steps to protect the shaft protecting sleeve’s surface from damage.
On pumps with double-acting mechanical seal, the mechanical seal chamber must be properly vented and the required pressure specified in the installation plan must be applied (also during standstill).

Quench liquid supply must also be ensured during pump standstill.

7.5.3.2 Mounting the gland packing

Always use pre-stressed packing rings, if possible.
Mount as follows:
Mount shaft protecting sleeve 524.02 (if any) onto the shaft using grub screws 904.2.
Insert the first packing ring into the stuffing box housing. Insert lantern ring 458 in such a way that the joint face is offset from the cut edge of the packing ring. Insert other packing rings with their cut edge displaced by 90º.
Slip on gland cover 452. Slightly tighten gland cover by hand using the two hex. nuts 920.13.
Caution!
The gland packing has no contact with the liquid handled and only seals against splashes and slight gas pressure.
Therefore the gland cover shall only be tightened slightly.
Dimensions of the packing chamber / number of packing rings.



7.5.4 Reassembly (general) - above floor

Place the half part of intermediary coupling (848) on the last intermediary shaft end (212) using the key (940.3), the washer (550.11) and the bolt (901.11).
Separately, pre-heat the bearing and inner spacer (504.2) by induction or oil bath up to 80ºC and slide them on the center sleeve (526).
Place the lock washer (931), screw the bearing nut (923), tight and lock it with the lock washer. Fix the deflector (508).
Fix the bottom bearing cover (360.1) or the bearing casing (350) and gasket 400.5 to the bearing bracket lantern (344).

Put the outer spacer (504.1) into the bearing housing 350. Mount the sub-assembly spacer sleeve + bearing into it. Put the drive shaft (213) with key (940.2) inside the spacer sleeve. Place the slip thrower (507), if any and bearing guard on to the bottom bearing cover. Align it with the intermediary coupling (848) and lock the ring (500). Place the upper part of intermediary coupling spacer and fix it with the bolts (901.12).
Place the flat gasket (400.3), the slip thrower (507), if any, and bearing guard (423.1) and close the support bearing with the upper bearing cover (360).
Before motor coupling adjust the **axial clearance**.

The **axial clearance** between impeller (230) and pressure cover (163) must be adjusted, using the adjust nut (923.2). For that, tight the nut until the impeller touches the pressure cover.
With a depth caliper gauge with depth gauge and using the reference surfaces of the shaft end and the adjust nut, down the rotor in **2,5 mm**.

Assemble the drive lantern (341) in the bearing bracket lantern (344), with the bolts (901.9).
Place the key (940.1) and the bottom half coupling (840) fixing it to the shaft with a grub screw.
Lift the pump set by the eye bolts (900.2) and place it on the foundation rail (89-8), if any, fixing it with the bolts (920.18). Couple the motor (801), fixing it to the drive lantern (341).
Note: In the case of pumps with columns above 3 meters, it should be assembled in the well and complying with the sequence already described.

7.5.5 Tightening torques

DENOMINATION		Stud (casing)	Stud (cover)	Hex. Head Bolt (bearing bracket)	Stud (seal cover)	Impeller nut
PART Nº		902.31	901.29	901.3	902.13	922
MATERIAL		Steel A193 Gr. B7	SAE1045 8.8	Steel A193 Gr. B7	AISI 316	AISI 316
PUMP SIZE		TORQUE (N.m)				
	25-180	190	120	40	50	80
	25-230	190	120	40	50	80
	40-180	190	120	40	50	80
	40-230	190	120	40	50	80
	50-200	385	120	40	50	130
	80-200	385	120	40	50	130
	40-280	385	120	40	50	130
	40-181	385	120	40	50	130
	40-231	385	120	40	50	130
	40-281	385	120	40	50	130
	40-361	385	120	40	50	130
	50-180	385	120	40	50	130

7.5.6 Diametral clearances

Pump size	Suction side Casing wear ring Nominal ID	Minimum clearance gap acc. to API 610	Clearance gap acc. to AN 1501 Gr. 2 (standard)	Discharge side Casing wear ring Nominal ID	Minimum clearance gap acc. to API 610	Clearance gap acc. to AN 1501 Gr. 2 (standard)
25-180	70	0,3	0,5	70	0,3	0,5
25-230	70	0,3	0,5	70	0,3	0,5
40-180	80	0,33	0,5	80	0,33	0,5
40-181	95	0,35	0,6	95	0,35	0,6
40-230	80	0,33	0,5	80	0,33	0,5
40-231	95	0,35	0,6	95	0,35	0,6
40-280	85	0,33	0,6	120	0,4	0,6
40-281	95	0,35	0,6	120	0,4	0,6
40-361	95	0,35	0,6	165	0,45	0,6
50-180	120	0,4	0,6	120	0,4	0,6
50-200	110	0,38	0,6	94	0,35	0,6
80-200	125	0,43	0,6	95	0,35	0,6

All the dimensions are in milimeters.
The performance curves are based on the standard clearances.
For any change in efficiency, please consult KSB.

7.6 Spare parts stock

When ordering spare parts, please indicate pump type and size, Production Order number, part name and number. These information can be obtained from the Data Sheet, Sectional Drawings and Parts List.

7.6.1 Recommended Spare parts for a 2 years´ operation to DIN 24296.

PART N°	DENOMINATION	NUMBER OF PUMPS (including stand-by pumps)						
		2	3	4	5	6	8	10 or more
		Spare Parts Quantity						
211/212/213	Shafts	1	1	2	2	2	3	30%
230	Impeller	1	1	2	2	2	3	30%
321	Bearing	1	1	2	2	3	4	50%
330	Bearing bracket	-	-	-	-	-	1	2 parts
383	Spider bearing	1	1	2	2	2	3	30%
411.31	Spiral wound	4	6	8	8	9	12	150%
423	Bearing guard	1	1	2	2	3	4	50%
433	Mechanical seal	1	1	1	2	2	2	20%
461 ①	Gland packing (set)	4	4	6	6	6	8	100%
502	Casing wear ring	2	2	2	3	3	4	50%
503	Impeller wear ring	2	2	2	3	3	4	50%
524	Shaft protective sleeve	1	1	1	2	2	2	20%
529	Bearing sleeve	1	1	2	2	3	4	50%
545	Bearing bush	1	1	2	2	3	4	50%
840	Coupling	1	1	2	2	2	3	30%
---	Gaskets and O'rings	4	6	8	8	9	12	150%

① If fitted

7.6.2 Interchangeability of pump components

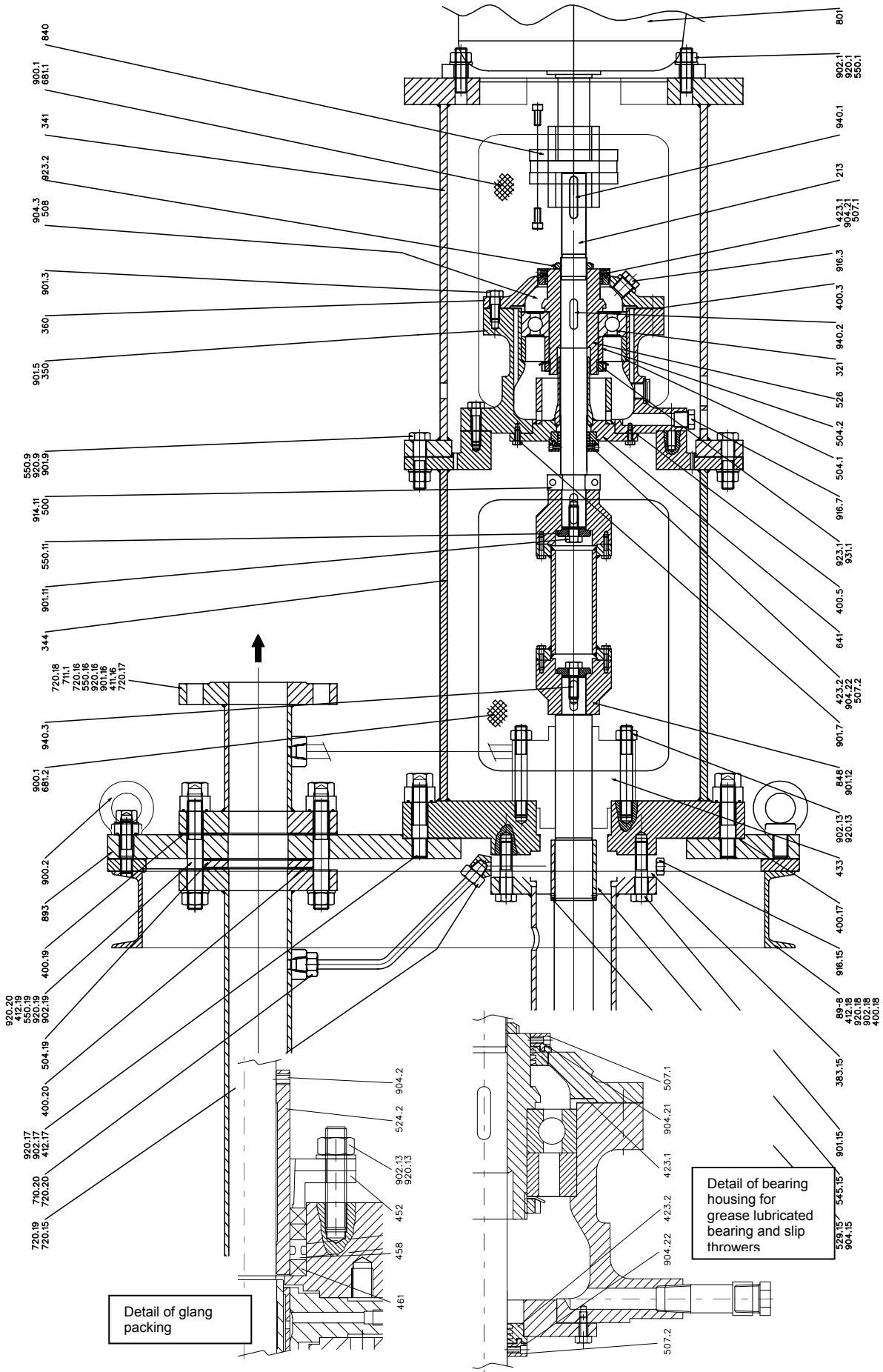
PUMP SIZE	DESCRIPTION	SPIRAL CASING	STRAINER	CASING COVER	PUMP SHAFT	INTERMEDIARY SHAFT	DRIVE SHAFT	IMPELLER	BEARING	BEARING BRACKET LANTERN	BEARING CASING	BEARING COVER	BEARING SPIDER	BEARING SPIDER	SPIRAL WOUND	BEARING GUARD	BEARING GUARD	MECHANICAL SEAL	SUCTION WEAR RING	DISCHARGE WEAR RING	SUCTION IMPELLER WEAR RING	DISCHARGE IMPELLER WEAR RING	SHAFT PROTECTIVE SLEEVE	INT COUPLING	SPLIT COUPLING	IMPELLER NUT	KEY	KEY
	PART Nº	102	143	161	211	212	213	230	321	344	350	360	383.15	383.21	411.31	423.1	423.2	433	502.1	502.2	503.1	503.2	524	848	853	922	940.5	940.1
25-180		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
25-230		2	1	2	1	1	1	2	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
40-180		3	2	1	1	1	1	3	1	1	1	1	1	1	1	1	2	1	2	2	2	2	1	1	1	1	1	1
40-230		4	2	2	1	1	1	4	1	1	1	1	1	1	2	1	2	1	2	2	2	2	1	1	1	1	1	1
50-200		5	3	3	1	1	1	5	1	1	1	1	1	1	3	1	2	1	3	8	3	8	1	1	1	1	1	1
80-200		6	4	4	1	1	1	6	1	1	1	1	1	1	3	1	2	1	4	6	4	6	1	1	1	1	1	1
40-280		7	2	5	2	1	1	7	1	1	1	1	1	1	4	1	2	1	5	7	5	7	2	1	1	2	2	1
40-181		8	2	1	2	1	1	8	1	1	1	1	1	1	1	1	2	1	6	6	6	6	2	1	1	2	2	1
40-231		9	2	2	2	1	1	9	1	1	1	1	1	1	2	1	2	1	6	6	6	6	2	1	1	2	2	1
40-281		10	2	5	2	1	1	10	1	1	1	1	1	1	4	1	2	1	6	7	6	7	2	1	1	2	2	1
40-361		11	2	6	2	1	1	11	1	1	1	1	1	1	5	1	2	1	6	9	6	9	2	1	1	2	2	1
50-180		12	3	1	2	1	1	12	1	1	1	1	1	1	1	1	2	1	7	7	7	7	2	1	1	2	2	1

8. Troubleshooting

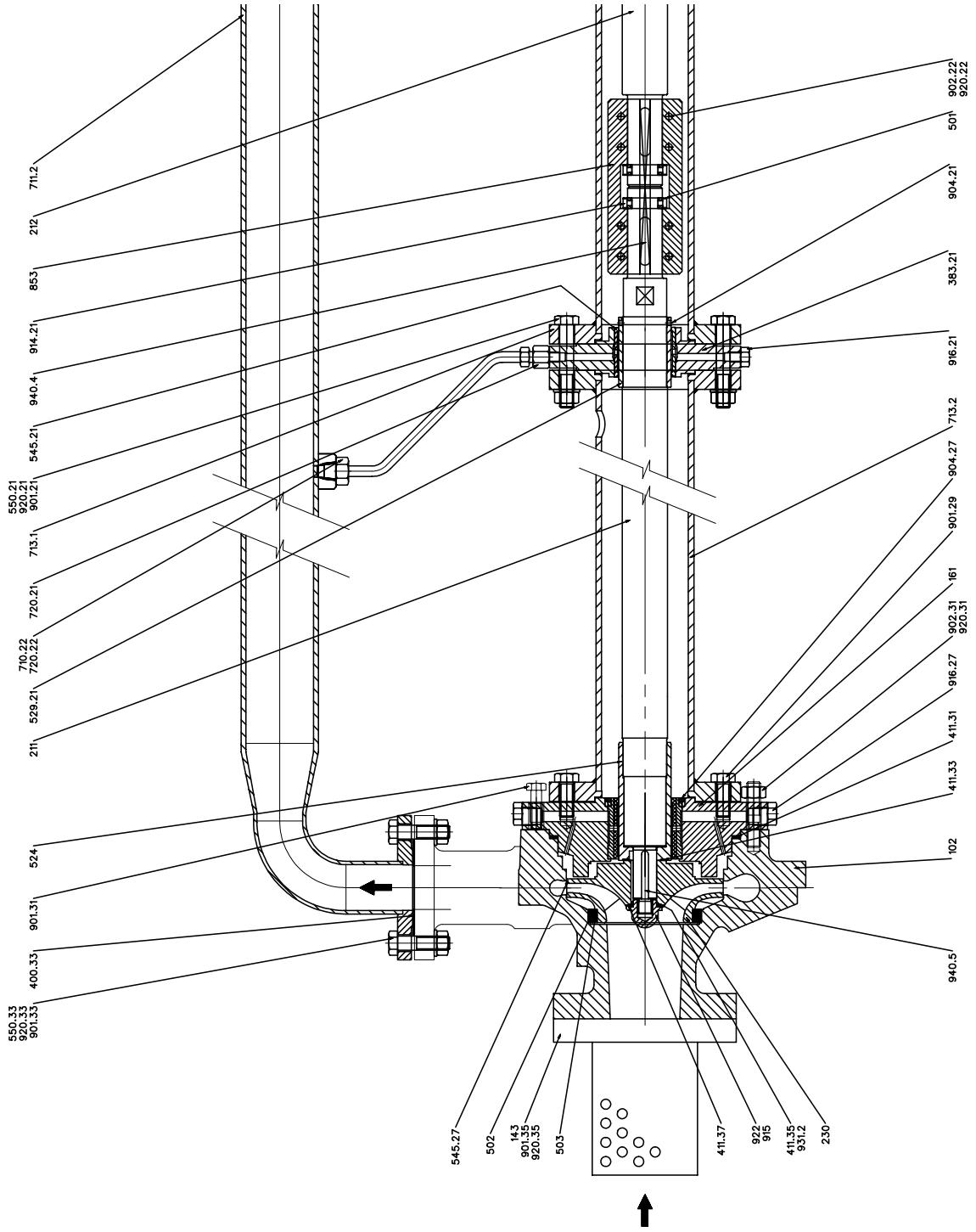
Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Increase in bearing temperature	Leakage at the pump	Excessive leakage at the shaft seal	Vibration during pump operation	Excessive rise of temperature inside the pump	Cause	Remedy [1]
•								Pump delivers against an excessively high discharge pressure.	Re-adjust duty point.
•								Excessively high back pressure.	Check plant for impurities. Increase the speed (turbine, I.C. engine).
•						•	•	Pump or piping are not completely vented or primed.	Vent and/or prime.
•								Supply line or impeller clogged.	Remove deposits in the pump and/or piping.
•								Formation of air pockets in the piping.	Alter piping layout. /Fit a vent valve.
			•		•	•		Pump is warped or sympathetic vibrations in the piping.	Check pipeline connection and secure fixing of pump; if required reduced the distance between the pipe clamps. Fix the pipelines using anti-vibration material.
•						•	•	Suction head is too high / NPSH available (positive suction head) is too low.	Check / alter liquid level. /Fully open shut-off valve in the suction head line. /Change suction line, if friction losses in the suction line are too high. Check any strainers installed / suction opening.
									Observe permissible speed of pressure fall.
			•					Increased axial thrust. [2]	Correct rotor adjustment.
•								Air intake at the shaft seal.	Fit new shaft seal.
•								Reverse rotation	Interchange two of the phases of the power supply cable.
•	•							Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
•								Speed is too low. [2]	Increase speed.
						•		Defective bearings.	Fit new bearings.
			•			•	•	Insufficient rate of flow.	Increase the minimum rate of flow.
•						•		Wear of internal pump parts.	Replace worn components by new ones.
	•					•		Pump back pressure is lower than specified in the purchase order.	Adjust duty point accurately.
	•							Density or viscosity of the fluid pumped is higher than stated in the purchase order.	[2]
	•				•			Use of unsuitable materials.	Change the Material combination.
		•						Speed is too high.	Reduce the speed. [2]
				•				Tie bolts/seals and gaskets.	Tighten the bolts. /Fit new seals and gaskets.
					•			Worn shaft seal.	Fit new shaft seal.
•					•			Score marks or roughness on shaft protecting sleeve.	Fit new shaft protecting sleeve. Fit new shaft seal / check the balancing line. Check the throttle bush / throttling sleeve clearances.
					•			Lack of cooling liquid or dirty cooling chamber.	Increase cooling liquid quantity. /Clean out cooling chamber. /Purify / clean cooling liquid.
					•			Vibrations during pump operation.	Improve suction conditions. /Re-align the pump. /Re-balance the impeller. /Increase the pressure at the pump suction nozzle.
			•		•	•		The unit is misaligned.	Check the coupling; re-align, if required.
			•					Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
			•					Non-compliance with specified coupling distance.	Correct distance according to the G.A. Drawing.
	•							Operating voltage is too low.	Increase the voltage.
						•		Rotor is out of balance .	Clean the impeller. /Re-balance the impeller.

1) Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.
2) Request particulars.

9. Sectional Drawing (part 1/2) - reference



Sectional Drawing (part 2/2)



Main parts list

Description	Part nº
VOLUTE CASING	102
STRAINER (OPTIONAL)	143
CASING COVER	161
PUMP SHAFT	211
INTERMEDIARY SHAFT	212
DRIVE SHAFT	213
IMPELLER	230
BEARING	321
DRIVE LANTERN	341
BEARING BRACKET LANTERN	344
BEARING CASING	350

Description	Part nº
BEARING COVER	360
SPIDER	383.15
SPIDER	383.21
SPIRAL WOUND	411.31
MECHANICAL SEAL	433
GLAND COVER	452
LANTERN RING	458
GLAND PACKING	461
WEAR RING	502
IMPELLER WEAR RING	503
SHAFT PROT.SLEEVE	524

Description	Part nº
CENTER SLEEVE	526
BEARING SLEEVE	529.15
BEARING SLEEVE	529.21
CONSTANT LEVEL OILER	638
RISING	711.1
RISING	711.2
SUSPENSION PIPING	713.1
SUSPENSION PIPING	713.2
IMPELLER NUT	922
BEARING NUT	923